

# Penetrating High-Resolution Inspection Tool for In-Process Control of Additive Manufacturing, Phase I

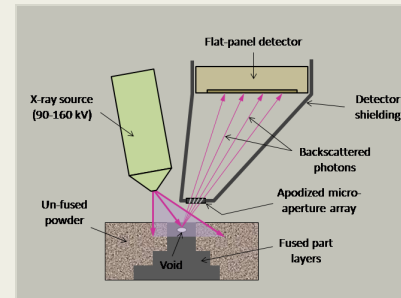
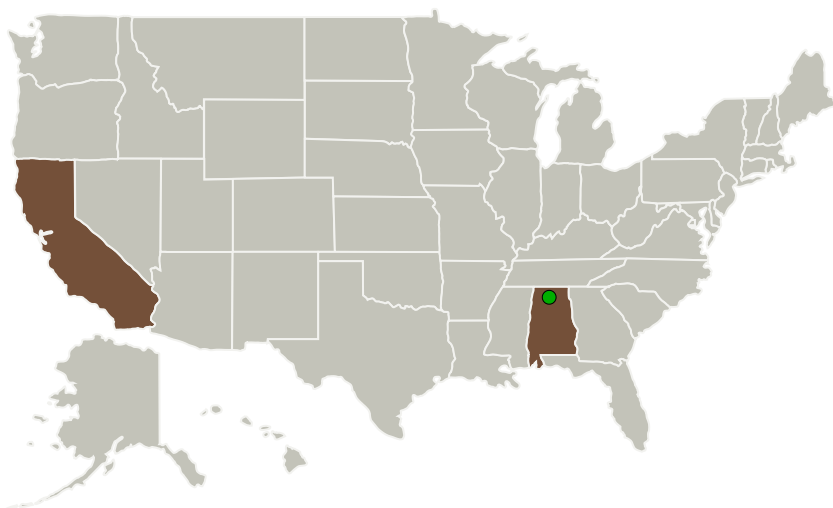
Completed Technology Project (2017 - 2017)



## Project Introduction

To address the NASA need for reliable in-process sensing and monitoring technologies for additive manufacturing (AM), Physical Optics Corporation (POC) proposes to develop a new Penetrating High-Resolution Inspection Tool (PHRUIT). The PHRUIT, intended primarily for layer-by-layer quality control in the power bed fusion (PBF) process, is based on innovative X-ray Compton backscatter microscopy, which enables single-sided, high-resolution ( $\sim 50$   $\mu\text{m}$ ), subsurface inspection of PBF parts. Due to the penetrating nature of X-rays, the PHRUIT will be able to inspect not only the surface of the last layer, but also the subsurface features, with typical penetration depths of 1-2 mm, and therefore will reveal voids and defects that are not visible with optical imaging. The PHRUIT will enable a user to "focus" on a particular depth within the part and localize any features or voids in x/y/z with accuracy of  $\sim 50$   $\mu\text{m}$ . The PHRUIT will have a capability to cover arbitrarily complex part profiles with two dimensional translation, with a total inspection time of typical parts of around 1-2 min. In Phase I, POC will demonstrate the feasibility of the PHRUIT high-resolution imaging approach by fabricating and testing a technology readiness level (TRL)-4 preliminary prototype. In Phase II, POC plans to develop a fully functional and integrated TRL-6 prototype and demonstrate its NDE capabilities to NASA by testing it with relevant PBF AM systems. At the end of Phase II, the PHRUIT system prototype will be delivered to NASA for further characterization.

## Primary U.S. Work Locations and Key Partners



Penetrating High-Resolution Inspection Tool for In-Process Control of Additive Manufacturing, Phase I Briefing Chart Image

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Organizations Performing Work	Role	Type	Location
Physical Optics Corporation	Lead Organization	Industry	Torrance, California
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	California

## Project Transitions

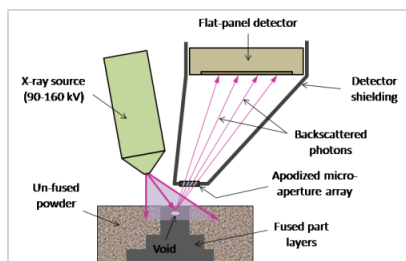
▶ **June 2017:** Project Start

✓ **December 2017:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140814>)

## Images



### Briefing Chart Image

Penetrating High-Resolution Inspection Tool for In-Process Control of Additive Manufacturing, Phase I Briefing Chart Image (<https://techport.nasa.gov/image/132943>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Physical Optics Corporation

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

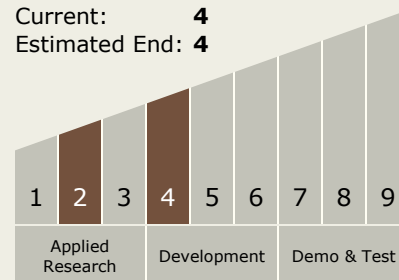
Carlos Torrez

### Principal Investigator:

Naibing Ma

## Technology Maturity (TRL)

Start: 2  
Current: 4  
Estimated End: 4



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## Technology Areas

### Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - └ TX12.2 Structures
    - └ TX12.2.2 Design and Certification Methods

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System